



## Materials Engineering Branch

### TIP\*



#### No. 107      Stress Corrosion Cracking of Gold over Electroless Nickel Plated Integrated Circuits

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Microcircuit leads are frequently made with Kovar (54% Fe, 29% Ni, 17% Co) or Alloy 42 (58% Fe, 42% Ni). When leads are plated with electroless nickel (ENi) and over-plated with gold, they may break off because of stress corrosion cracking<sup>1</sup>. Microcircuit leads may break before, during and after attachment to the printed wire assemblies.

Kovar and Alloy 42 lead materials are ductile iron alloys. ENi is often very brittle<sup>2</sup>. When an ENi plated Kovar lead is bent during handling or installation, the electroless nickel plating may crack. If the ENi plating has been gold plated, the gold also cracks and remains bonded to the ENi plating. Each crack has gold on the outside, ENi in the middle and Kovar at the base. A galvanic cell is developed between the gold and the Kovar. Solder flux residue, chlorine or other contaminants may collect in the cracks and react with water vapor in the air causing stress corrosion cracking through the Kovar or Alloy 42 leads, resulting in catastrophic lead failure. Without the gold plating, the stress corrosion cracking problem is less severe.

In order to avoid this problem, the MIL-PRF-38535F microcircuit military specification should be followed closely. The specification prohibits the use of gold plating over electroless nickel on flexible leads but requires the use of hot solder dip over leads plated with electroless nickel<sup>3</sup>.

<sup>1</sup> GSFC Document X-310-76-71, March 1976, Greenbelt, MD 20771.

<sup>2</sup> Metals Handbook, 9<sup>th</sup> Edition, Volume 5, "Surface Cleaning, Finishing and Coating", ASM, Metals Park, OH 44073.

<sup>3</sup> General Specification for Integrated Circuits Manufacturing, MIL-PRF-38535F, December 2002.